



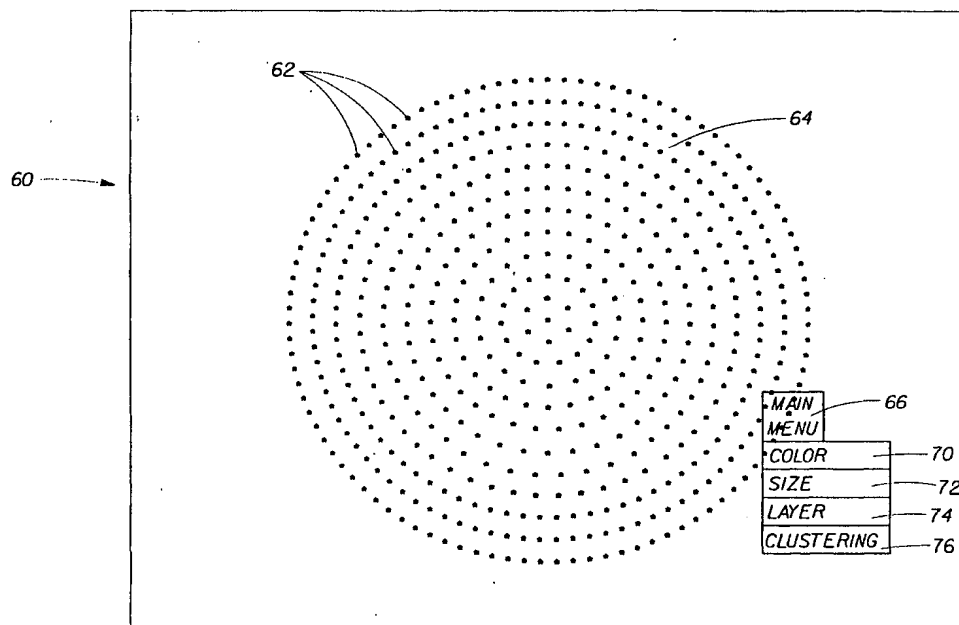
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(54) Title: METHOD AND APPARATUS FOR INTERACTIVELY DISPLAYING THREE-DIMENSIONAL REPRESENTATIONS OF DATABASE CONTENTS

(57) Abstract

A computerized, interactive, graphical display system in which a database of technical documents, such as patents and patent publications developed from an on-line database search, may be represented as data objects in a virtual three-dimensional space. The data objects are grouped into a universe (64) of virtual galaxies by a number of user-selected common attributes. A user may identify terms or values of interest for each of the selected attributes in order to tailor the representation to the particular interests of the user. Each of the selected attributes is associated with a distinctive visual criteria for enabling the user to distinguish between the different attributes, and values identified for each attribute, in the display. The distinct visual



criteria include varying the color (70), size (72) and layers (74) within the galaxies depending upon different values for the selected attributes, as well as clustering (76) the galaxies on the display by an additional common attribute. The user may navigate through the three-dimensional space to view the virtual galaxies, as well as penetrate particular galaxies of interest to view individual documents. As the user navigates into a galaxy, the galaxy is changed into a set of data objects that each represent an individual technical document. As the user approaches particular data objects, titles and images from the represented documents appear on the screen. An object may be selected on the display to view the text of the document.

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METHOD AND APPARATUS FOR INTERACTIVELY DISPLAYING THREE-
DIMENSIONAL REPRESENTATIONS OF DATABASE CONTENTS

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TECHNICAL FIELD

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The present invention relates generally to a computerized display system and is particularly directed to a computerized display system of the type which graphically depicts the contents of a database. The invention is specifically disclosed as an interactive, three-dimensional information display system for grouping and viewing a database of technical documents.

BACKGROUND OF THE INVENTION

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The Internet has provided free access to many technical documents, including United States Patents, to every engineer and scientist that is equipped with a computer, a modem, and a browser. However, it is impossible for an individual human mind to encompass this vast expanse of data. Knowledge of the boundaries of existing technology is nevertheless a pre-condition for cost-effective research and development, as opposed to blind efforts that may recreate what is already known in the art.

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Software tools are being developed to automate the data gathering process from on-line technical databases, as well as the presentation of the gathered documents. These software tools include the automated formation of technical searches to identify documents containing keywords or terms in an on-line database. An exemplary automated data gathering system is described in a commonly-assigned United States Patent application entitled METHOD AND APPARATUS FOR BUILDING A USER-DEFINED TECHNICAL THESAURUS USING ON-LINE DATABASES, which is filed concurrently herewith, and which is incorporated herein by reference in its entirety. In the exemplary system, the user engages in an interactive, on-line process of identifying key words and

equivalent terms to achieve a "crafted query," which is then submitted to an on-line technical database to identify pertinent documents, such as patents and patent publications.

A database may be built from the on-line search results and displayed on a spreadsheet or in a graphical format, such as a bar chart or plot. While these display formats enable the user to view the search results and identify similarities in individual text fields, it can be difficult and time-consuming to identify technical trends from these formats, or to track the overall activity of a particular inventor or organization.

Alternative graphical formats have been utilized to display the contents of other, non-technical databases. These formats have included hyperbolic trees which depict database records grouped by certain common attributes into "nodes." Each node may be linked by branches to other nodes representing records with some common attributes but also with certain differences, in order to form a tree structure. The hyperbolic tree structure may be viewed as an earth surface projection in which the nodes appear as if located on the surface of a sphere, and selection of a primary node may trigger the display of secondary nodes branching from the primary.

In addition to hyperbolic trees, it is known to use a three-dimensional information "landscape" to graphically depict data relationships. In particular, U.S. Patent No. 5,555,354 (by Strasnick) discloses a three-dimensional information display landscape in which collections of three-dimensional bar charts are grouped and interconnected into a topology through which a user may navigate in order to discern data relationships. In this information landscape, the graphic objects comprise columns, pedestals, and disks, with the different types of graphic objects depicting different hierarchies within the database contents. While the three-dimensional landscape disclosed in the Strasnick patent increases the user's perception and comprehension of the data, the landscape depicts data within a hierarchical relationship and does not provide for the graphical display of a non-hierarchical database, such as a database of technical documents. Further, the disclosed landscape does not provide for the interactive grouping of data objects based upon user-selected common attributes.

Accordingly, it would be desirable to provide a computerized display system for graphically depicting database contents which provides the increased visual comprehension of a three-dimensional display, yet also enables the database contents to be interactively grouped by user-selected attributes. Further, it would be desirable to provide such a

computerized display system which can interactively display a database of non-hierarchical technical documents, such as patents.

SUMMARY OF THE INVENTION

5 Accordingly, it is a primary advantage of the present invention to provide a computerized system and method for interactively displaying a three-dimensional representation of database contents, including where the database contents may be interactively grouped by user-selected attributes. It is another advantage of the present invention to provide a computerized system for displaying a three-dimensional
10 representation of a database of technical documents, such as patents and patent publications, obtained from an on-line database search. It is yet another advantage of the present invention to provide a computerized system for displaying a three-dimensional database representation, in which the database contents may be interactively grouped by common attributes, and the results of each grouping are immediately displayed for the
15 user. It is a further advantage of the present invention to provide a computerized system for displaying technical documents in which a user may navigate through a three-dimensional representation of the documents in order to selectively view titles, images, and text. It is yet a further advantage of the present invention to provide a computerized, three-dimensional database display system in which the database contents may be
20 interactively grouped within the display by user-selected attributes, and each of the attributes distinguishable by a distinct visual criteria.

 Additional advantages and other novel features of the invention will be set forth in part in the description that follows and in part will become apparent to those skilled in the art upon examination of the following or may be learned with the practice of the
25 invention.

 To achieve the foregoing and other advantages, and in accordance with one aspect of the present invention, a computerized, interactive, graphical display system is provided in which a database of technical documents, such as patents and patent publications developed from an on-line database search, may be represented as data objects in a virtual
30 three-dimensional (3-D) space. The data objects are grouped into virtual galaxies by a number of user-selected common attributes. A user may identify terms or values of interest for each of the selected attributes in order to tailor the 3-D representation to the

particular interests of the user. Each of the selected attributes is associated with a distinctive visual criteria for enabling the user to distinguish between the different attributes, and values identified for each attribute, in the display. Examples of the distinctive visual criteria include varying the color, size, and layers of galaxies within the 3-D space depending upon different possible values for the selected attributes, as well as clustering the galaxies in the 3-D displayed space by an additional common attribute. Once the attributes have been assigned by the user, he or she may navigate through the 3-D space to view the virtual galaxies, as well as penetrate particular galaxies of interest to view individual documents. As the user navigates into a galaxy, the galaxy is changed into a set of data objects appearing as colored stars that each represent an individual technical document. As the user approaches particular objects, titles and images appear identifying the corresponding documents. A particular object may be selected from the display to view the text of the document.

Still other advantages of the present invention will become apparent to those skilled in this art from the following description and drawings wherein there is described and shown a preferred embodiment of this invention in one of the best modes contemplated for carrying out the invention. As will be realized, the invention is capable of other different embodiments, and its several details are capable of modification in various, obvious aspects all without departing from the invention. Accordingly, the drawings and descriptions will be regarded as illustrative in nature and not as restrictive.

BRIEF DESCRIPTION OF THE DRAWINGS

While the specification concludes with claims particularly pointing out and distinctly claiming the present invention, it is believed the same will be better understood from the following description taken in conjunction with the accompanying drawings in which:

Figure 1 is a block diagram of the major components of an interactive graphical display system, as constructed according to the principles of the present invention;

Figure 2 is an exemplary screen display of an initial virtual universe of stars and the Main Menu for selecting display criteria;

Figure 3 is an exemplary screen display similar to Figure 2 of the universe of stars, depicting the Color Menu for selecting a color attribute;

Figure 4 is an exemplary screen display of the universe of stars of Figure 3, altered to reflect selection of a color attribute, and depicting the Size Menu in a default mode;

Figure 4A is an exemplary screen display similar to Figure 4, depicting the Size Menu and selection of a size attribute in a non-default mode;

5 Figure 5 is an exemplary screen display depicting the universe of stars of Figure 4 grouped into galaxies by the color and size attributes, and depicting the Layer Menu for selecting a layer attribute;

10 Figure 6 is an exemplary screen display depicting the galaxies of the universe of stars of Figure 5, further organized into three-dimensional layers according to the layer attribute, and depicting the Clustering Menu for selecting a clustering attribute;

Figure 7 is an exemplary screen display depicting the three-dimensional universe of Figure 6 organized by color, galaxy, size, layer, and clusters according to the selected attributes, at the point of initial navigation into the universe;

15 Figure 8 is an exemplary screen display of the three-dimensional universe of Figure 7, depicting the user navigating towards a particular galaxy;

Figure 9 is an exemplary screen display depicting the three-dimensional universe of Figure 8, while navigation within a particular galaxy and illustrating the plurality of stars within the galaxy; and

20 Figure 10 is a flow chart showing the major steps utilized by the present invention in organizing the 3-D universe of documents into galaxies based upon user-selected attributes, and then navigating among the galaxies.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

25 Reference will now be made in detail to the present preferred embodiment of the invention, an example of which is illustrated in the accompanying drawings, wherein like numerals indicate the same elements throughout the views. Referring now to the drawings, Figure 1 depicts a personal computer or workstation generally designated by the reference numeral 10, for operating the preferred embodiment of the present invention. The computer 10 is electrically connected to a video monitor 12 and a printer
30 14. Video monitor 12 is controlled by a video controller 20 that is contained within the computer 10, and is connected to the monitor by a video cable 22.

Computer 10 is controlled by some type of central processing unit (CPU) 30, which typically comprises a microprocessor. CPU 30 controls virtually everything that occurs within the computer 10, and communicates with the other electronic components via a data/address/control bus 28. CPU 30 accesses memory circuits 32, such as random
5 access memory (RAM) and read only memory (ROM). In the present invention, it would be desirable to have a bulk memory storage device 34, such as a large hard disk drive. Depending upon the amount of data to be stored, a read/write compact disc drive might be even more useful than a hard disk drive for use as the bulk memory storage device 34.

Computer 10 will require some type of keyboard 42 and some type of cursor
10 pointing device, such as a mouse 46. Keyboard 42 is connected via a keyboard cable 44 to an input/output interface circuit 40. Mouse 46 is connected through a mouse cable 48 to another port of the input/output interface 40.

Assuming a printer is desirable, the printer 14 is connected by a printer cable 26 into one of the communication ports 24 of the computer 10. The printer 14 could be
15 connected through a network, rather than having a direct connection as shown in Figure 1. The communication ports 24 will preferably also include a modem (not shown) that can connect to an outside communication link 52, such as a telephone line. This communication link 52 is connected to a network service provider 50, which is sometimes referred to as an "ISP" for "Internet Service Provider."

20 As is commonly known, the Internet is a world-wide network of computers that is accessible by virtually any user having a computer with a modem. In Figure 1, the Internet is depicted by the reference numeral 60. The user of computer 10 may access the Internet 60 using his or her network service provider 50. Once connected into the Internet 60, the user can access information at other web sites via other ISP's, such as at reference
25 numerals 62, 64, and 66. A number of web sites contain patent information, such as patent documents issued by the U.S. Patent and Trademark Office at 72, the European Patent Office at 74, or the Japanese Patent Office at 76. For example, the IBM Corporation has a web site of United States patents that are accessible at "http://patent.womplex.ibm.com." In addition to patents, other technical documents may
30 also be obtained from web sites using the Internet. Thus, using the Internet and these various web sites, technical personnel may conduct state-of-the-art and prior art searches on-line, and develop databases of technical documents. As mentioned hereinabove, a

commonly assigned U.S. Patent Application, Serial No. 09_____, entitled METHOD AND APPARATUS FOR BUILDING A USER-DEFINED TECHNICAL THESAURUS USING ON-LINE DATABASES, filed concurrently herewith, describes a preferred process for developing such a database using a crafted query.

5 Once a database has been developed, the present invention provides a method and apparatus for interactively organizing and displaying the database, so that the user may quickly and efficiently identify and decipher pertinent information. While it is envisioned that the present invention will be particularly useful in viewing patent documents developed from an on-line database search, it will be understood that the invention is not
10 limited to this application, but rather may be used for displaying any type of database containing technical or even non-technical documents. A preferred embodiment of the invention will now be described in detail for a database of U.S. patent documents developed using a crafted query as discussed above.

 The operation of the present invention may be initiated by clicking on an icon
15 from an initial command screen displayed on video monitor 12. This initial command screen is preferably the screen that is presented upon entering the WINDOWS® operating system, or another comparable type of graphical user interface operating system. Alternatively, the invention may be initiated by selecting the program from a set of menu choices displayed through the WINDOWS operating system. Once the software of the
20 present invention has been activated, the user preferably will be prompted for the name or other identifying indicia of the database or file of patent documents to be displayed. In addition, the user can be prompted for the crafted query used to develop part or all of the database, or for the filename under which the crafted query is stored in the bulk memory device 34.

25 After a valid database name or identifier has been entered, the database is accessed from bulk memory 34 and an initial screen 60, shown in Figure 2, is displayed on video monitor 12. As shown in Figure 2, this initial screen 60 depicts the database contents as a plurality of data objects, each of the objects representing one of the patent documents in the database. In this initial screen 60, the patents are all represented in the same manner,
30 with no distinguishing criteria therebetween. In the preferred embodiment, the patents are represented as a circular field of evenly sized and spaced white stars 62 located in a dark background or "universe" 64. Each of the stars 62 is mapped to a patent in the database,

so that selecting a star accesses the particular patent from the database. While the data objects appear as stars in the preferred embodiment shown, it will be understood that other types of objects could be utilized to represent the patents or patent publications without departing from the principles of the invention.

5 A Main Menu 66 is located at a lower right corner of initial screen 60, and is preferably transparent so as not to obstruct the field of stars 62. Main Menu 66 includes a number of criteria for grouping and distinguishing between the patents or "stars" 62 in a meaningful way, in order to increase the user's ability to comprehend the patents and identify similarities and trends therebetween. In the preferred embodiment shown in
10 Figure 2, the Main Menu 66 includes the following four criteria: "Color" at 70, "Size" at 72, "Layer" at 74, and "Clustering" at 76, which will each be described in more detail below. Preferably, the criteria listed in Main Menu 66 are stepped through one-by-one by the user in an interactive manner so that the three-dimensional database display is set-up in a way that is most beneficial to the user. Because the user has an interactive role in the
15 display set-up, and preferably can immediately view the results of the individual selections made, the user can continually change the display until the patents are grouped into an easily comprehended format.

Figure 3 illustrates an exemplary screen display 78 for the Color Menu 80, which is accessed by selecting the "Color" criterion 70 from Main Menu 66 on Figure 2. When
20 first entering the Color Menu 80, display screen 78 depicts the field of white stars 62 until at least one common attribute is selected. Through the Color Menu 80, a common attribute may be identified for the field of documents or stars 62, and the stars are then colored in a variety of hues to distinguish between the documents, based upon information entered for the attribute. In the embodiment illustrated in Figure 3, the
25 attributes that may be selected from the Color Menu 80 include "All" at 82, "Relevance" at 84, "Inventor" at 86, "Assignee" at 88, "PTO Class" at 90, "Issue Date" at 92, "Application Date" at 94, and "Phrase/Term" at 96.

Many of the listed attributes coincide with fields that appear in U.S. Patent documents. However, as mentioned above, the present invention may also be used to
30 display non-patent documents. In such cases, the attributes may vary to coincide with fields common in the type of documents being displayed. For example, the attributes "Author," "Grant No.," or "Publication Date" may be used for a display of non-patent

technical publications or articles. The attributes 82-96 for the Color criterion 70 are listed along the right side of display screen 78. In the illustrated example, "Assignee" 88 has been selected as the attribute by which to distinguish between the universe of stars 62. The choice of Assignee 88 is evidenced by the phrase "By Assignee" within the double-bordered box 98, at the bottom of the attribute list.

As shown in the lower right of screen 78, the Color Menu 80 includes a column of color blocks 100 in which each block is a different primary or secondary color. For example, the first block 102 could be red, the second block 104 green, the third block 106 blue, the fourth block 108 yellow, and so forth, as designated by the blocks 110, for as many different colors as desired be represented in the display. While an initial set of colors preferably appears by default, these colors may be changed to suit the user by adjusting the control panel settings in the WINDOWS system.

To the right of each of the color blocks 102, 104, 106, 108, and 110 are text fields 112 for assigning a particular name, entity, or value to each block. Since Assignee 88 is the selected attribute in the example shown, particular patent assignees of interest are entered into the text fields 112, such that each assignee is paired with a color in column 100. In the example shown, the assignee "Acme" is paired with the red block 102, the assignee "A-1 Inc." is paired with the green block 104, the assignee "Prime Corp." is paired with the blue block 106, and "Any Other" is paired with the yellow block 108. A scroll bar 114 may be located to the right of the text fields 112 for viewing additional colors and text fields when more colors and assignees are identified than can appear in the Color Menu window at one time.

After one or more assignees have been entered into text fields 112, the entries are compared with the patents in the database to identify those patents listing the designated assignees. Immediately following this comparison, the stars representing the identified patents are altered in the display to reflect the color corresponding to the assignee. Figure 4 illustrates an updated screen display 116 altered in this manner, in which the patents assigned to Acme are now represented as red stars 102a, the patents assigned to A-1, Inc. are represented as green stars 104a, the patents assigned to Prime Corp. are represented as blue stars 106a, and the remaining ("Any Other") patents are represented by yellow stars 108a to indicate an other, non-identified assignee. For simplicity of illustration, only a few stars are identified by reference numbers in Figure 4. However, it is to be understood

that each star in the display would be altered from white to one of the listed colors red, green, blue, or yellow so as to correspond to the represented patent.

While the Assignee attribute 88 was selected in the example shown, any of the other attributes could have also been selected, and a similar procedure followed to "color" the stars. For example, if "Inventor" at 86 were the selected attribute, then one or more inventor names would be entered in the text fields 112, and the stars colored according to the listed names. Likewise, if "PTO Class" at 90 were the selected attribute, then PTO classes would be entered in the text fields 112 and assigned to the color blocks 102-110. If "Issue Date" at 92 were the selected attribute, then patent issue dates (e.g., by year) would be entered in fields 112; and if "Application Date" at 94 were selected, then patent application dates would be entered in fields 112, and the field of stars 62 would be colored according to the designated dates. If the "All" attribute 82 were selected, then the field of stars would all change from white to a single designated color, such as the red of the first color block 102. Similarly, if "Relevance" at 84 were selected, then the stars would be colored based upon the total number of search terms or "hits" found in each patent. Finally, if "Phrase/Term" at 96 were selected, then a star would be colored if the represented patent contains one or more of the search terms assigned to a color. If a particular patent contains more than one of the search terms listed in fields 112, then the patent would be represented by multiple stars, one each of a color corresponding to one of the listed search terms that appears in the patent. Alternatively, if a patent contains more than one listed search term, a single star could represent the patent having the color of the search term that appears most often in the patent.

After the colored stars 62 are initially displayed, the selected attribute may be changed in Color Menu 80, i.e., such as the use of "PTO Class" at 90 instead of "Assignee" at 88, and text fields 112 altered accordingly to reflect the different attribute. Likewise, the colors in column 100 may be changed, or colors may be added or deleted, to reflect the selected attribute and desires of the user. After each of these changes, the display of colored stars in screen 116 preferably is automatically altered to reflect the changes. In this way, the user may interactively change the display until arriving at a representation that best suits the needs of the user. After entries and changes to the Color Menu 80 are complete, the user may exit this menu and return to Main Menu 66.

Figure 4 depicts a Size Menu 126 on the right side of the updated display 116. The Size Menu 126 is reached by selecting the Size criterion 72 from Main Menu 66 (see Figure 2). Similar to the other menus provided by the invention, Size Menu 126 is preferably transparent to enable the underlying display to appear while selections and entries are being made at this menu. The Size Menu 126 is preferably accessed after the Color Menu 80, in order to group the colored stars by a second common attribute. In the preferred embodiment, the stars are grouped by this second attribute into separate, differently-sized galaxies, an example of which is illustrated in Figure 5. These galaxies are depicted as being elliptically-shaped in the figures, however, the galaxies may also be presented in other shapes without departing from the principles of the invention.

As depicted in Figure 4, Size Menu 126 includes the same attributes as before: "All" at 82, "Relevance" at 84, "Inventor" at 86, "Assignee" at 88, "PTO Class" at 90, "Issue Date" at 92, "Application Date" at 94, and "Phrase/Term" at 96 (which were described above in conjunction with the Color Menu 80). In addition to these listed attributes, the Size Menu 126 preferably also includes a default attribute "Number Of Patents In A Galaxy," identified by reference numeral 128. With regard to this default attribute 128, the search query from the on-line database search is accessed, and each of the terms in the query is compared against the text of the patents in the database to identify the number of times each of the terms appears in the patents. The search terms are then ranked in text fields 129 of the Size Menu 126 in descending order of appearance in the documents. For example, in the exemplary database illustrated in Figure 4, the search term "ultraviolet" appears most often in the patents and, thus, is listed first in the Size Menu 126. The search term "web" has the second highest number of occurrences in the patents and is listed second in the Size Menu 126. The search term "fiber" has the third highest number of occurrences and, therefore, is listed third, and so forth.

A column of number blocks 130, similar to the color block column 100 of Color Menu 80, is located adjacent to text fields 129. Each of the blocks in column 130 is associated with one of the search terms in text fields 129. In the default mode, the numeric value contained within number blocks 130 represents the total number of patents in which the associated search term appeared. Therefore, in the illustrated example of Figure 4, the first number block, identified by the reference numeral 132, contains the number "20," indicating that twenty (20) of the patents in the database include the term

"ultraviolet." Likewise, the second number block at 134 contains the number "15," indicating that the term "web" appears in fifteen (15) of the patents, while the third number block at 136 contains the number "10," indicating that the term "fiber" appears in ten (10) of the patents, and so forth.

5 In addition to identifying the search terms in the Size Menu 126, the present invention also groups the stars 62 into galaxies of common terms, with the size of each galaxy corresponding to the size of the number assigned to the term in column 130. Thus, all of the patents having the search term "ultraviolet" will be grouped into a galaxy having the largest size, while the patents having the search term "web" will be grouped into a
10 second galaxy of slightly smaller size, and the patents having the third term "fiber" into yet a smaller galaxy, and so forth for each of the listed search terms (see Figure 5, for example). In order to still distinguish the patents by color, and to build on the previously selected color attribute rather than override it, the galaxies of stars are temporarily grouped by color. Accordingly, if two different assignees own patents having the term
15 "ultraviolet," such as, for example, Acme and A-1, Inc., then two galaxies of the same size will be displayed, each in a color corresponding to the particular assignee.

This grouping of patents into galaxies will be better understood by viewing Figure 5, which illustrates four sets (or clusters) of galaxies, one for each of the four colors designated in the Color Menu 80. In Figure 5, for example, red galaxies are designated
20 by reference numeral 102b, green galaxies are designated by reference numeral 104b, blue galaxies are designated by reference numeral 106b, and yellow galaxies are designated by reference numeral 108b. Within each of the color groupings 102b, 104b, 106b, and 108b is a plurality of galaxies 148, each galaxy corresponding to one of the search terms in the Size Menu 126. As mentioned above, within each color grouping the galaxies are sized
25 according to the frequency of occurrence of each search term in the patents. Therefore, within each of the color groupings 102b, 104b, 106b, and 108b, the largest galaxy (per group), identified as 132, corresponds to the term "ultraviolet," the second largest galaxy (per group), identified as 134, corresponds to the term "web," and the third largest galaxy (per group), identified as 136, corresponds to the term "fiber."

30 As mentioned above, "Number Of Patents In A Galaxy," identified as 128, is a default attribute for the Size Menu 126. Accordingly, a switch 150 such as shown in the lower left corner of Figure 4, is preferably provided for overriding this default mode.

When the switch 150 is set to "Auto", as it is in Figure 4, then the terms from the database search are automatically listed in text fields 129 in the order of numeric occurrence, as described above for the default mode. However, if switch 150 is set to "Manual", the default attribute is overridden, and the user selects from among the attributes 82-96 listed in the menu.

Figure 4A depicts an exemplary display for using the Size Menu 126 when the default attribute switch 150 is set to "Manual." In the manual mode, an attribute is selected from those listed in Size Menu 126. In the example shown, the attribute "Phrase/Term" at 96 has been selected as the attribute by which to group the stars 62 into galaxies. The selection of the Phrase/Term attribute 96 is confirmed to the user by the notation "By Phrase/Term" in double-bordered box 98. Similar to Figure 4, a column of blocks 152 is located in Size Menu 126 for differentiating between the sizes of the galaxies. In the manual mode, column 152 preferably initially includes several blocks numbered in descending order, such that the first block 156 contains "20", for example, and corresponds to the first of the text fields 154, the second block 158 contains a lesser number, and corresponds to the second of the text fields, and so forth. Although the column 152 initially includes a given number of blocks, extra blocks can be added or deleted from the column to suit the number of text entries for the selected attribute. The numbers in the blocks may also be changed so as to skip numbers, such as shown in Figure 4A by the skip between block 158 containing "19" and block 160 containing "15." Skipping numbers between blocks provides a greater physical size differential between the galaxies in the display, since each of the galaxies is approximately sized according to its corresponding number in column 152.

Next to the numbered blocks in column 152 are text fields 154 for listing specific values or terms for the selected attribute. In the example shown in Figure 4A, in which "Phrase/Term" is the selected attribute, the term "Filter" is entered in the first text field 154 next to first block 156, the term "Cellulose" is entered in the second field next to the second block 158, and the term "TiO₂ Photocatalyst" is entered in the third field next to block 160. If an attribute other than "Phrase/Term" had been selected for the Size Menu, then information such as Application Date, Issue Date, or PTO Class would have been entered in the text fields 154 to coincide with the selected attribute, such as described above with respect to the Color Menu 80.

After the desired terms/phrases are entered into text fields 154 on Figure 4A, the colored stars 102a-108a are grouped into galaxies corresponding to the terms/phrases in a manner similar to that described with respect to Figures 4 and 5. In particular, all of the patents having the term "Filter" would be grouped into the largest sized galaxy (e.g., galaxies 132), those having the term "Cellulose" would be grouped into the second largest sized galaxy (e.g., galaxies 134), and so forth. Again, the galaxies would be grouped by colors, in a manner similar to that depicted in Figure 5, so that the patents can be distinguished by both color and phrase/term. Accordingly, there would be a "Filter" galaxy (e.g., 132) for each Assignee that owned patents containing this term, a "Cellulose" galaxy (e.g., 134) for each Assignee that owned patents containing this term, and so forth.

As mentioned above, the present invention provides for an interactive display in which an attribute may be selected from a menu and the display immediately updated to reflect the selection. The interactive functioning of the display enables changes to be repeatedly made to any of the menus, and the effects of the changes presented immediately to the user, so that the display can be tailored to provide precisely the type of information of interest to the user in the most comprehensible format. Accordingly, for the Size Menu 126 the selected attribute and information in blocks 152 and fields 154 may be continually changed, and the display altered accordingly, until the user is satisfied with the grouping of the patents into galaxies. After all changes are complete, control may be returned to the Main Menu 66.

Returning now to Figure 5, which depicts a two-dimensional display 147 in which the colored stars are grouped into galaxies 148, it will be seen that a Layer Menu 170 is provided for selecting a third attribute by which to distinguish between the patents. Up to this point, the patent database has been represented in only two dimensions, and by two attributes, i.e., by color and galaxy. Through the Layer Menu 170, a third common attribute may be selected and the patents graphically distinguished in a third manner via three-dimensional layering. The Layer Menu 170 is accessed by selecting the Layer criterion 74 from Main Menu 66. As shown in Figure 5, the Layer Menu 170 includes the same listed attributes "All" at 82, "Relevance" at 84, "Inventor" at 86, "Assignee" at 88, "PTO Class" at 90, "Issue Date" at 92, "Application Date" at 94, and "Phrase/Term" at 96, as with the previous color and Size Menus 80 and 126. In the example shown, the issue

date attribute 92 has been selected and confirmed to the user by the phrase "By Issue Date" in box 98.

In addition to the listed attributes, Layer Menu 170 includes a column of blocks 172 and corresponding text fields 174, similar to the columns and text fields in the previously described menus. As shown in Figure 5, the blocks in column 172 are preferably numbered in ascending order to signify the layer in the display which corresponds to the text field. Accordingly, patents matching the information or value entered next to the first column block 176 will appear in the first layer of the display, those matching the text next to the second block 178 will appear in the second layer of the display, and so forth. In the listed example, only five text fields are displayed for Issue Dates occurring in the years 1995-1999. However, the data presented in the example of Figure 5 assumes that the patent search query was limited to these five years, although any number of text fields and blocks could be utilized, depending upon the selected attribute and the conditions presented in the search query, without departing from the principles of the invention.

After the information for the selected attribute is entered into text fields 174, the display is updated to reflect the third common attribute. Figure 6 illustrates such an updated screen display 179, in which the patent database representation is updated to reflect this three-dimensional layering. In the updated display, the patent database is still grouped into galaxies 148 that are clustered by colors 102b, 104b, 106b, and 108b (see Figure 5), but in addition to these characteristics, the galaxies are now also broken out into layers corresponding to the selected Issue Date attribute.

As shown in Figure 6, each of the colored galaxies may include patents having a number of different issue dates. To distinguish between these issue dates, each original galaxy 148 is split into layers, with each layer being spaced from the preceding and succeeding layers and represented by a different visual pattern for purposes of this illustration of Figure 6. For example, in Figure 6 the first layer (representing patents having an issue date in 1999) is represented by ellipses having a solid border, such as identified by reference numeral 180. The second layer, corresponding to patents having an issue date in 1998, is represented by ellipses having a dashed line border, such as that identified by reference numeral 182. Likewise, the third layer, corresponding to patents

issued in 1997, is represented by ellipses having a dotted line border, such as identified by reference numeral 184.

On an actual computer display—using a color monitor—the different ellipses would each be of a single color (e.g., red, blue, green, or yellow), and the "borders" would merely be the delineation between the color and the black universe background, except for situations where multiple galaxies are layered in one "x-y" location on the screen. In that situation, when one galaxy can be viewed as being positioned "behind" a closer galaxy, then the closer galaxy will preferably have a small line-type edge so as to make it clear to the user where one galaxy of one color stops, and a second galaxy (of the same color) starts. Additional layers may thereby be represented on the display, each with a different border location, to coincide with the number of layers designated in the Layer Menu 170.

When multiple layers exist for the same particular galaxy x-y location, the layers are preferably "stacked" (along a z-axis) in an offset manner so that each of the lower levels is partially visible about an edge of the preceding layers. This offset stacking will be better understood by viewing Figure 6, in which a "galaxy set" indicated generally by the reference numeral 188 includes a first, solid layer 190, a second, dashed layer 192 partially visible about the boundary of the first layer, and a third, dotted layer 194 which is partially visible about the boundary 192 of the second layer. Additionally, a galaxy may include patents corresponding exclusively to one or more of the lower layers, such as the galaxy set indicated by reference numeral 198 which includes only the second, dashed layer at 197 and the third, dotted layer at 199.

In an alternative embodiment, multiple layers within a galaxy may be stacked on top of each other in the display, so that when viewed from a distance only a single, topmost layer appears. In this alternative embodiment, the lower layers would become visible only upon navigating through or around the closer galaxies, as will be described in more detail below.

In addition to depicting an updated, three-dimensional representation of the patent database, Figure 6 also includes a fourth, Clustering Menu 200 for selecting a fourth common attribute for the database. The Clustering Menu 200 is accessed by selecting the Clustering criterion 76 from the Main Menu 66, and is preferably accessed only after attributes have been selected for each of the other three criteria. Through the Clustering

Menu 200, the three-dimensional display can be further modified by clustering the galaxies according to an additional attribute. The Clustering Menu 200 includes the same attributes 82-96 as the preceding Color, Size, and Layer Menus, with the selected attribute being again indicated in box 98. In the example shown in Figure 6, "PTO Class" is the selected attribute.

Also similar to the preceding menus, the Clustering Menu 200 includes a column of blocks 202, and text fields 204 for entering terms and values for the selected attribute. In the example shown, PTO Class 287 is entered for the first "A" block 206, PTO Class 288 is entered for the second "B" block 208, and a third PTO Class 289 is entered for the third "C" block 210. The illustrated example includes only these three abstract PTO Classes under the assumption that the database search was limited to these classes. However, it is to be understood that a greater or lesser number of entries could be made in the Clustering Menu 200 without departing from the principles of the invention.

Figure 7 illustrates an updated display 212 in which the example three-dimensional database representation has been updated to reflect clustering of the patents according to PTO Class. Prior to selecting a Clustering attribute, the galaxies 148 were clustered strictly according to color. Thus, as seen in Figure 6, red galaxies were clustered together at the area indicated by reference numeral 102c, green galaxies were clustered together at the area indicated by reference numeral 104c, and so forth for clustered blue galaxies at 106c and yellow galaxies at 108c. However, in the updated display of Figure 7, the clustering has been altered so that the galaxies maintaining the designated colors are reclustered (i.e., repositioned on the screen 212) by PTO Class. Preferably each of the patents is clustered according to only the dominant PTO Class. Thus, as shown in Figure 7, the galaxies containing patents in PTO Class 287, for example, are clustered as indicated by the reference numeral 214, the galaxies corresponding to PTO Class 288, for example, are clustered as indicated by the reference numeral 216, and the galaxies corresponding to PTO Class 289, for example, are clustered as indicated by the reference numeral 218. Within each of the clusters 214, 216, and 218, the galaxies maintain the previously designated attributes, as indicated by the red 102b, green 104b, blue 106b, and yellow 108b galaxies with clusters 212 and 214, and the different sizes and layers of the galaxies as indicated by reference numerals 132, 134, 136 and 180, 182, and 184. Preferably the x-y coordinate spacing between the clustered

galaxies is minimized without creating any overlap or confusion between galaxies on the same layer. If only a single entry is made for the selected attribute, or if the selected attribute is "All," the galaxies will all appear in one cluster centered on the screen (e.g., about the point at 240).

5 Similar to the other menus, the clustering arrangement shown in Figure 7 can be altered by returning to Clustering Menu 200 on Figure 6 and changing the selected attribute, or entering different information or values for the selected attribute in text fields 204. After any changes, the display will again be updated to reflect the changes. After all changes to the color, size, layer, and clustering arrangements are complete, the user may
10 exit the set-up mode and enter a navigation mode to selectively view the database patents.

 The description of the navigation mode begins with the example three-dimensional, updated representation of the database illustrated in Figure 7. As mentioned above, at this point the database representation has been grouped by four different attributes that are common to all the documents in the database. In the navigation mode,
15 the user "travels" among the grouped patents in three-dimensional "space" to inspect the number and types of patents in each grouping, as well as to identify key patents of interest. The navigational mode preferably operates as a "head up" display in which the user's position remains stationary while the three-dimensional representation changes positions on the screen, so that the user has the sensation of moving through the display
20 field.

 Upon entering the navigation mode a set of directional controls, generally indicated by the reference numeral 220, are provided on the screen. These controls enable the user to navigate through and between the universe of galaxies. The controls 220 include up and down arrows 222 and 224 for moving the user in a vertical direction
25 through the display, and left and right arrows 226 and 228 for moving the user in a sideways direction through the display. In and out controls 230 and 232 are also provided for navigating in and out of the display in the "z" direction (representing depth), which will be described in further detail below. Likewise, slow and fast controls 234 and 236 control the navigation velocity through the display. In addition to the screen controls 220,
30 the user may navigate through the universe of galaxies using the mouse 46. In one particular exemplary mode of operation, the user may hold down the left mouse button to go forward into the display or towards an object, or may hold down the right mouse

button to move away from an object or move in reverse through the display. Likewise, the user may move the mouse 46 left, right, up, or down to virtually move in a corresponding direction within the display.

In the navigation mode, the user may traverse the universe however he or she sees fit in order to "browse" the database. When first entering the navigation mode, the user appears at an initial position some distance away from the first layer of the galaxies, as illustrated in Figure 7. A cross-hair point at 240 provides a visual indication of the user's position within the display. As the user navigates towards a particular cluster, and then towards a galaxy within the cluster, the galaxies increase in size. As the user approaches a particular galaxy, this galaxy is centered on the screen, and continues to increase in size while the surrounding galaxies drop off of the screen to give the appearance of "flying" through the universe. Navigation among the galaxies can be better understood from viewing Figures 7 and 8, in which it can be seen that the galaxies in cluster 214 initially appear in Figure 7 as being off in the distance. However, as the user navigates towards a particular galaxy, such as galaxy set "A" in cluster 214, that galaxy set "A" as well as the immediately adjacent galaxies (identified as letters "B" through "F" in Figures 7-8) increase in size. As the user continues to navigate towards a particular galaxy, surrounding galaxies continue to get larger until eventually dropping off the edges of the display, as illustrated in Figure 8 at the letters "G" and "H". As the user continues to approach a particular galaxy set, such as "A," the separate layers of the galaxy set become more distinguishable, and the spacing between the layers increases to enable navigation between the layers (e.g., layers "X" and "Y", at galaxy set "A").

After targeting a particular galaxy, the user may penetrate and enter the virtual galaxy. Preferably, each layer of a galaxy set may be entered as a separate galaxy, so that the user views only the patents corresponding to one layer. As a single galaxy is penetrated, the patents represented by that galaxy appear as individual data objects or stars spaced across the display, as illustrated, for example, in Figure 9. The stars are preferably organized on the display according to the selected attributes. In particular, if the Phrase/Term attribute has been selected, such as illustrated by Figure 4A in the example described, then the stars are organized according to the number of times each phrase or term is found in each patent, such that the patents having the highest number of identified phrases and search terms are located in the center of the galaxy, while the

patents having decreasing numbers of search terms or "hits" are spaced out from the center and so that the patents having the lowest number of hits are spaced around the outside of the galaxy field. If phrase/term was not a selected attribute, then the stars or patents are organized on the display, for example, by issue date, and then by patent number, with the most recently issued patents being located in the center of the display.

If, for example, the color attribute had been chosen as "Issue Date," then it would be quite likely that a single galaxy could contain stars of more than one color.

As the user travels towards individual stars in a galaxy, information from the face of each document preferably appears on the display, as indicated in Figure 9. In particular, as the user approaches a star, the patent number, located at 250, and front page image (or other image) located at 252, are displayed. The user may select a patent by double clicking the mouse 46 on the patent number 250 in order to view the text of the patent. After viewing the patent, the user may approach and double click on another nearby patent, may move around the layer to view other patent numbers and images, may move to another layer within the galaxy set, or may exit the galaxy set and navigate towards a different galaxy or galaxy set, for example, by moving in reverse through the display and then forward into the display towards another galaxy. In essence, the navigation mode is comparable to outer space travel, with the user "flying" among the galaxies to view the patents having the selected attributes corresponding to each color, cluster, galaxy, and layer. The user is free to move around within the universe of galaxies to selectively view the full content of the database.

It is preferred to be able to visually indicate the fact that a particular star (i.e., document) has been previously "visited" during this navigation session, or even during a previous navigation session. One method for creating a clearly noticeable visual indication is to cause the colored star to become a much darker shade, perhaps by use of a Gray-scale dither pattern to be overlaid on the original star color. Another such method is to allow the user to choose his or her own star color to indicate the previous visit. There also could be two different visual cues to indicate whether the previous visit was during the current or a previous navigation session.

Figure 10 is a flow chart depicting the logical steps used in the interactive set-up of and navigation through the three-dimensional database representation of the present invention. Starting at a functional step 500, the user enters the set-up mode to begin

grouping the patent database by common attributes. At this point in the procedure, the database contents are represented as a field of white stars in a universe, and the user is presented with the Main Menu, both of which are depicted in Figure 2. At a decision step 502, the user selects a display criteria from Main Menu 66. As mentioned above, the display criteria are preferably selected one-by-one in the order listed, such that the color criteria is first selected in step 502. If the user chooses not to select any display criteria in decision step 502, then the process passes directly to the navigation mode at step 528. In this case, since the user bypassed the display set-up, the database would be represented only as the field of white stars without any distinguishing groupings or colors.

After the user selects the color criteria in step 502, the set-up routine passes to a step 504. In step 504, an attribute is chosen for the color criteria, and values or information corresponding to that attribute are entered into the text fields, as shown in Figure 3. After information is entered in the text fields, the set-up routine moves to a step 506 at which the preliminary resulting display is shown, with the field of stars colored according to the selected attribute, as illustrated in Figure 4. Next, the set-up routine passes to a decision step 508 at which the user determines whether the updated display of colored stars is correct, or whether changes are to be made to the previously selected attribute. If the answer at decision step 508 is NO, then the routine returns to step 504, at which point a new color attribute may be selected, or different information or values may be entered for the attribute. If the answer at decision step 508 is YES, then the set-up routine continues to step 510.

In a step 510, a check is made of the default switch for the size attribute, which is illustrated in Figures 4 and 4A. If the default switch is set to "Auto," such as shown in Figure 4, then the Size Menu lists the search terms from the on-line search in descending order of appearance. At a step 512, a preliminary display is presented in which the documents are grouped into galaxies based upon the search terms, with the size of each galaxy corresponding to the frequency of occurrence of each search term, such as depicted in Figure 5.

Alternatively, if the default switch is set to "Manual," such as shown in Figure 4A, then an attribute is selected from the Size Menu, and values for the selected attribute are entered into the corresponding text fields. The updated preliminary display is presented at step 512 depicting the patents grouped into galaxies according to the selected attribute.

Next, the set-up routine passes to a decision step 514 at which the user determines if the preliminary resulting display is correct. If the answer at step 514 is NO, then control passes back to step 510 at which point a different size attribute may be chosen, different values entered for the selected attribute, or the default switch altered to change between the modes. If the answer at step 514 is YES, then the set-up routine continues to a step 516 where an attribute is selected from the Layer Menu, which is illustrated in Figure 5.

After a layer attribute is selected, a preliminary display depicting the galaxies divided into three-dimensional layers according to the selected attribute, such as illustrated in Figure 6, is presented at a step 518. At a decision step 520 the user determines whether or not the display depicting the galaxies broken out into layers is correct. If the answer at step 520 is NO, then the set-up routine returns to step 516 to select a different attribute for the layer criteria, or to identify different values for the selected attribute. If the answer at step 520 is YES, then the set-up routine continues to a step 522, where the user selects an attribute by which to cluster the galaxies, and identifies information to distinguish each cluster, such as depicted in Figure 6.

After the clustering attribute is selected and values entered, the set-up routine passes to a step 524 where a preliminary resulting display is presented depicting the patents grouped by color, galaxy, layer, and cluster, such as illustrated in Figure 7. At a decision step 526 the user determines whether or not the final preliminary resulting display is correct. If the answer at step 526 is NO, then the set-up routine returns to step 522 where the clustering attribute may be modified as desired by the user. If the answer at step 526 is YES, then the set-up portion of the invention is complete, and control passes to the navigation mode at a step 528.

It should be noted that, at any point during the set-up routine, the user may return to any of the attribute selection menus, not just the most recent menu. For example, if at step 522 a decision is made that the appearance of the display is not correct and that the selected attribute for color needs to be modified, the set-up routine may return to step 504 to make the necessary modifications (via an alternate logic pathway 532). Since each of the four criteria are executed from the Main Menu 66 (on the display), modifications can be made to any of the selected attributes by logically following anywhere on alternate pathway 532 (including the Main Menu "Enter Set-up Mode" step at 500) and selecting the corresponding criteria. After the required modifications are made to the selected

attributes, the display will be updated immediately to reflect the change. As mentioned previously, it is in this manner that the display may be tailored to represent the database in the most efficient manner.

5 Upon entering the navigation mode at step 528, the user may "fly" through the universe of galaxies and penetrate those of interest to view individual patents. If at any time during the navigation, a decision is made to vary one or more attributes, such as indicated by a "Main Menu—Vary Attributes" step 530, the routine may return to any of the "choose attribute" steps 504, 510, 516, or 522, as indicated by alternate pathway 532, in order to change the display. After the changes are complete, the display will be
10 updated to reflect the changes, and the user may return to the navigation mode at step 528 by a short cut to browse the modified display.

The foregoing description of a preferred embodiment of the invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Obvious modifications or
15 variations are possible in light of the above teachings. The embodiment was chosen and described in order to best illustrate the principles of the invention and its practical application to thereby enable one of ordinary skill in the art to best utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the claims
20 appended hereto.

What is claimed is:

1. A computerized method for displaying a three-dimensional representation of a database of documents, said documents having a plurality of common attributes, comprising the steps of: representing each of said documents by a separate data object on a display; said method characterized by the steps of:
 - selecting from among said plurality of common attributes by which to distinguish between said data objects; identifying values for each of said selected attributes; associating each of said selected attributes and corresponding identified values with distinctive visual criteria such that values for said selected attributes of each data object may be distinguished by said criteria; altering the representation of said data objects on said display to reflect said distinctive visual criteria; and navigating among said data objects in a virtual three-dimensional space to selectively view on said display individual documents based upon said distinctive visual criteria.
2. The method as recited in claim 1, wherein selecting from among said plurality of common attributes, associating said selected attributes with distinctive visual criteria, and representing the data objects on said display are interactive functions.
3. The method as recited in any above claim, wherein said display is immediately updated to reflect selection of a common attribute and association of said selected common attribute with distinctive visual criteria.
4. The method as recited in claim 3, wherein associating each of said selected attributes with distinctive visual criteria further comprises the step of: (a) associating a first of said selected attributes with a color criteria such that each data object is displayed in a pre-determined color if a value of said first selected attribute contained in said represented document corresponds to an identified value for said first selected attribute; or (b) grouping said data objects into a plurality of virtual galaxies, each galaxy corresponding to an identified value for a

second of said selected attributes, said data objects being grouped into said galaxies according to the value of said second selected attribute contained in each said represented document.

5. The method as recited in claim 4, wherein associating each of said selected attributes with a distinctive visual criteria further comprises: (a) separating each of said virtual galaxies into layers according to a third selected attribute, each of said layers corresponding to an identified value for the third selected attribute, and said data objects being grouped into said layers according to the value of said third selected attribute contained in each represented document; or (b) grouping said virtual galaxies into clusters according to a fourth selected attribute, each said galaxy being grouped into a cluster when a value of said fourth selected attribute contained in each of said represented documents in the galaxy corresponds to a value identified for said cluster.
6. The method as recited in any above claim, wherein said documents are technical reference documents; or wherein said technical reference documents are patent publications.
7. The method as recited in claim 6, wherein said database of patent publications was developed through an on-line database search.
8. The method as recited in any above claim, wherein said step of navigating among said data objects further comprises: traveling in said three-dimensional space through a universe of said virtual galaxies, and increasing and decreasing sizes of said galaxies as a user approaches or recedes from said galaxies.
9. The method as recited in claim 8, wherein said user may navigate within a particular galaxy to view individual data objects within said galaxy; or wherein as a user approaches a particular data object a patent number and an associated image appears on said display.

10. A computerized, graphical display system for displaying a three-dimensional representation of a database of documents, said documents having a plurality of common attributes, comprising: a computer having a processing circuit, a memory circuit, a communication circuit and a video monitor, said computer being configured to represent each of said documents by a separate data object on said video monitor; said system characterized in that:

said computer displays a listing of said common attributes on said video monitor, and inputs user selections of said common attributes for distinguishing between said data objects; inputs user-identified values for each of said user-selected attributes; associates each of said user-selected attributes and corresponding identified values with distinctive visual criteria such that values for said selected attributes in each represented document may be distinguished by said criteria; updates a representation of said data objects on said video monitor to reflect said distinctive visual criteria; and navigates among said data objects in a virtual three-dimensional space to selectively view on said video monitor individual documents based upon said distinctive visual criteria.
11. The computerized system as recited in claim 10, wherein said computer functions interactively upon receiving user-selected attributes and identified values, and updates said display quickly to reflect said input; or wherein said documents are patent publications; or wherein said distinctive visual criteria comprises virtual galaxies of said data objects, each of said virtual galaxies being distinguishable by values identified for said user-selected attributes.
12. The computerized system as recited in claim 11, wherein said distinctive visual criteria further comprises coloring, layering, and clustering of said virtual galaxies according to said user-selected attributes.
13. A method for interactively displaying a computerized, three-dimensional representation of a database of documents having a plurality of common attributes,

comprising the steps of: representing each of the documents as a separate data object on a display; said method characterized by the steps of:

prompting a user to select from among said plurality of common attributes particular attributes of interest; grouping a plurality of said data objects into virtual galaxies in a virtual three-dimensional space by said user-selected attributes, each of said user-selected attributes being characterized in said display by distinct criteria indicative of values associated with said user-selected attributes in said documents; continually updating said displayed representation to reflect changes in said user-selected attributes or in values associated with the attributes; and navigating within said virtual galaxies in said three-dimensional space to selectively view individual documents.

14. The method as recited in claim 13, wherein said virtual galaxies are clustered by x-y coordinates on said display according to a user-selected attribute; or wherein said virtual galaxies are layered in a z-axis, according to a user-selected attribute.
15. The method as recited in claim 13, further comprising viewing text and images of an individual document.
16. A method of interactively displaying a database of documents having a plurality of common attributes, comprising the steps of: representing each of the documents as a data object in a virtual three-dimensional space; said method characterized by the steps of:

grouping a plurality of said data objects into virtual galaxies in said three-dimensional space by a number of distinct criteria, each criteria being associated with a user-selected attribute common to said documents, and identifying values for said attribute by which to distinguish between said documents; updating said display after selection of each attribute; and navigating through a virtual universe of said virtual galaxies to selectively view said database documents.

17. The method as recited in claim 16, wherein said criteria comprise: color, layer, size, and clustering; or wherein each of said data objects visually appears as an individual star in one of said virtual galaxies.
18. The method as recited in claim 17, wherein a color of said individual star noticeably changes after a visit by a user while navigating.

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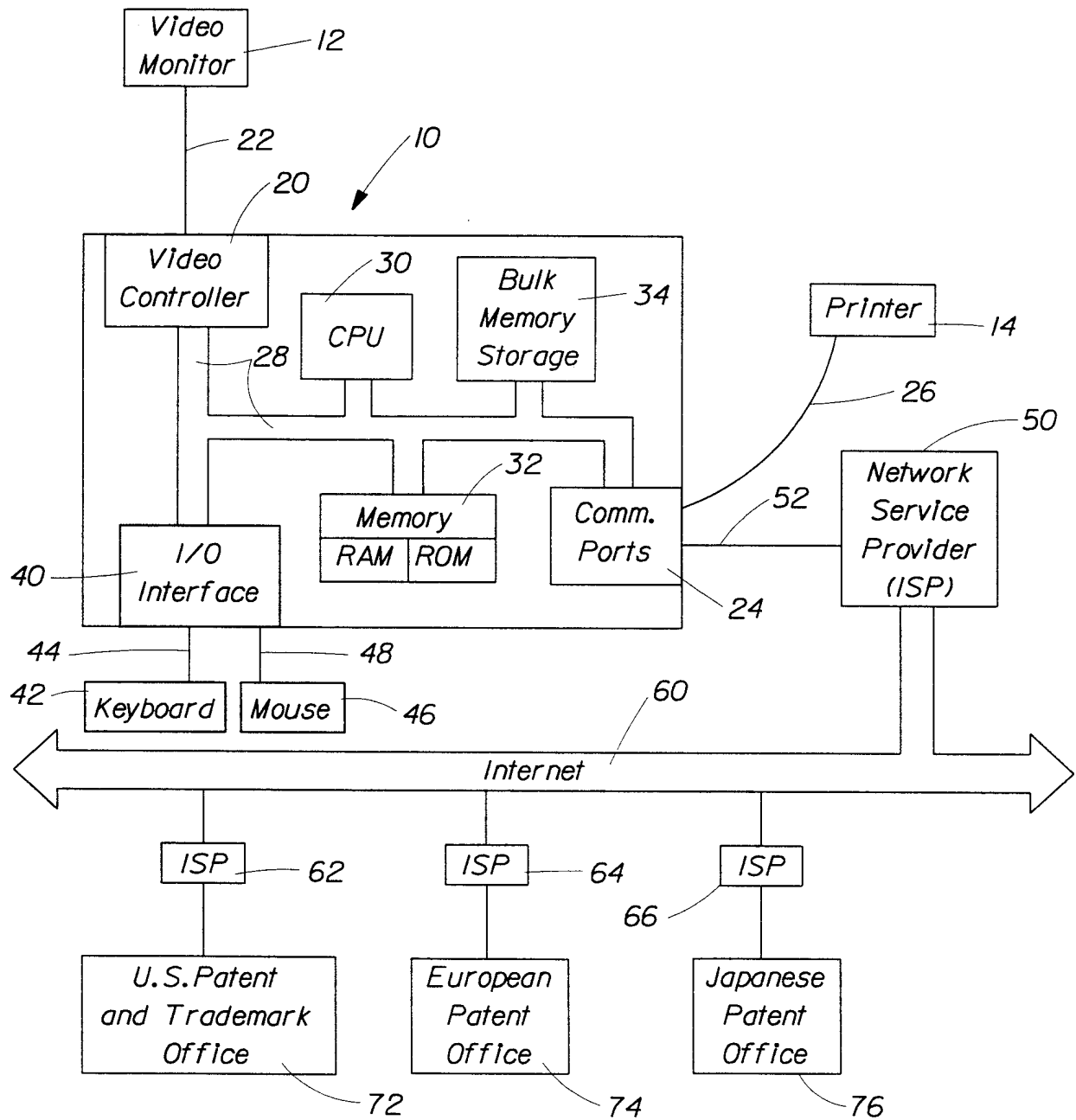
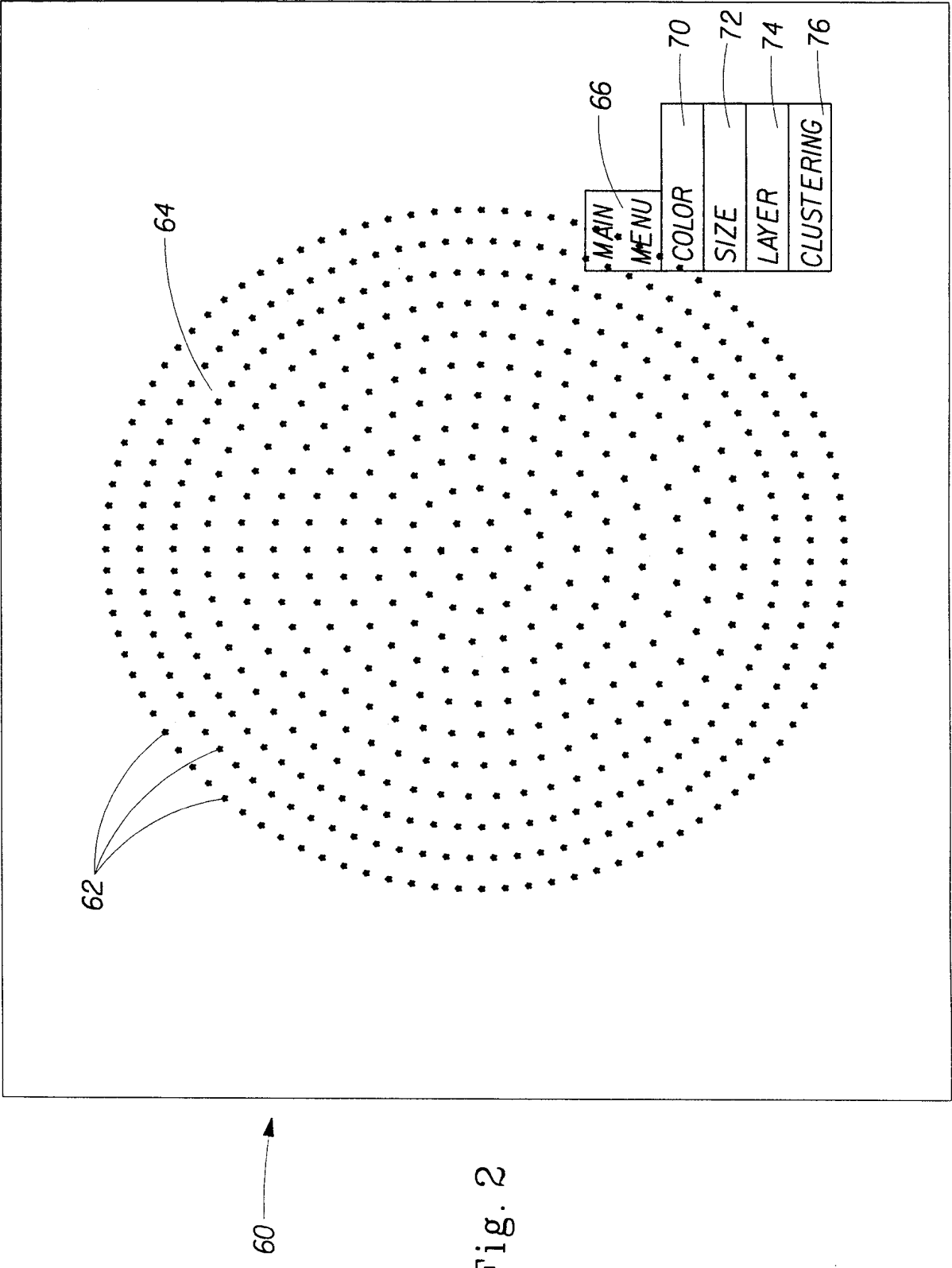


Fig. 1



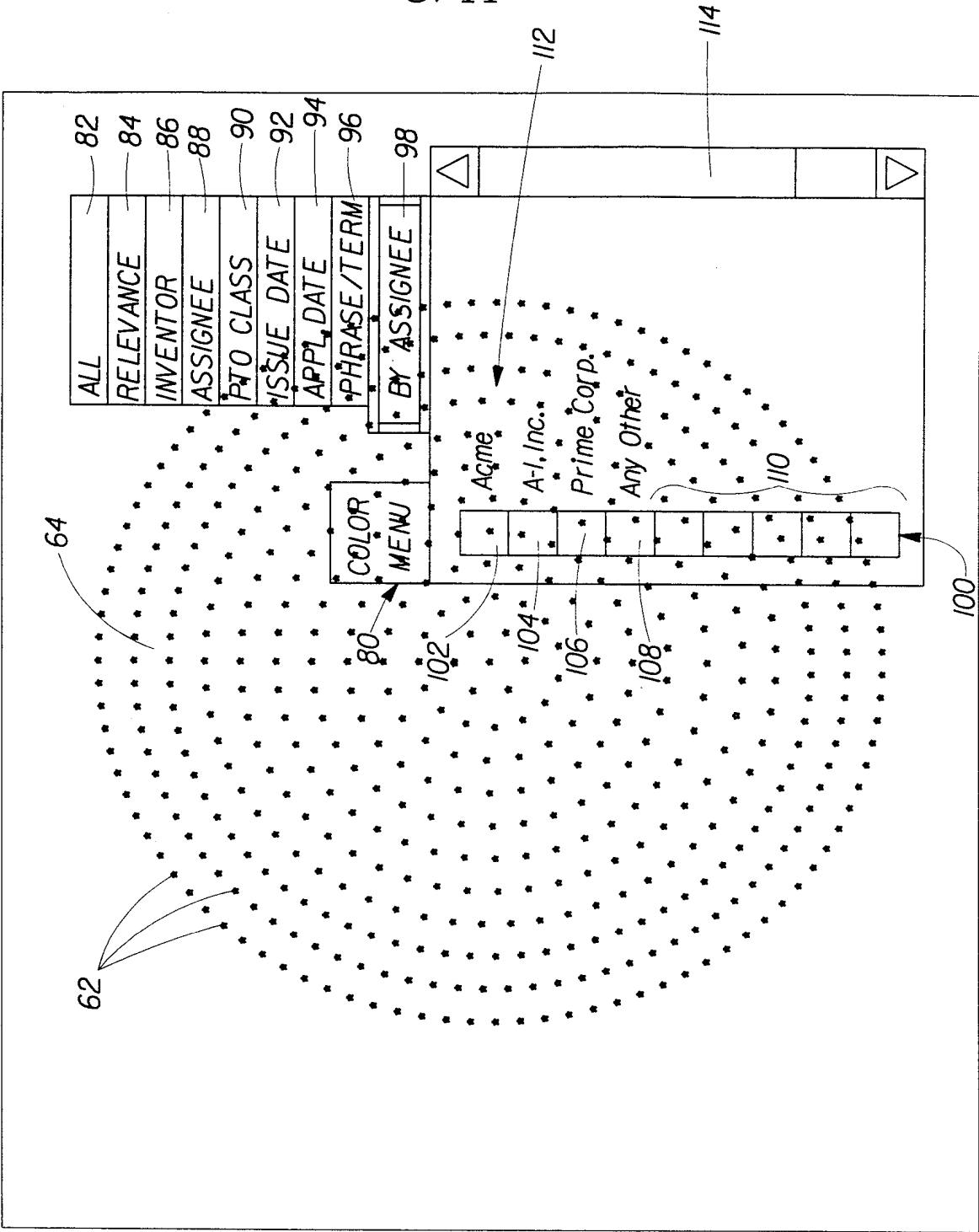
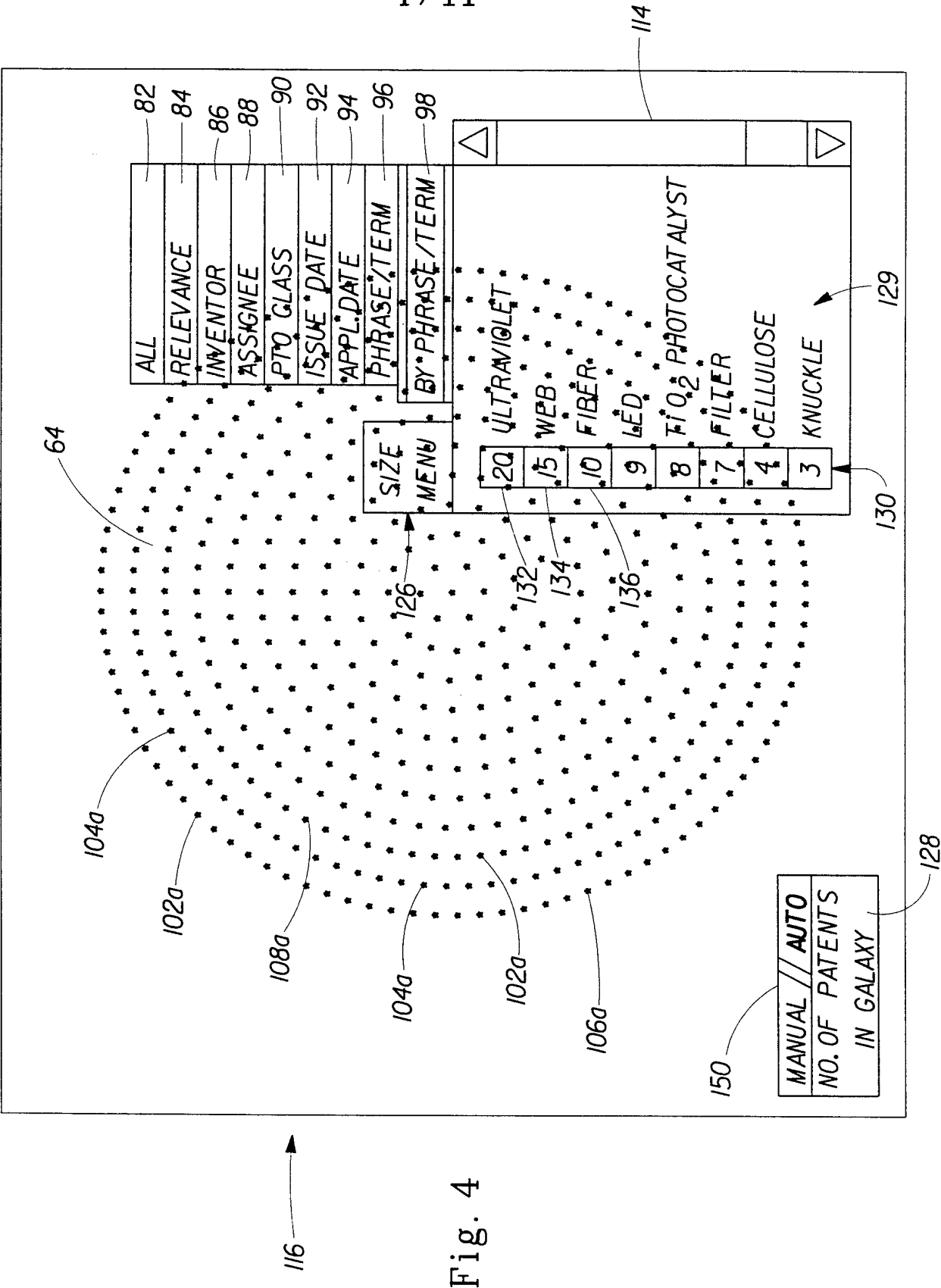


Fig. 3



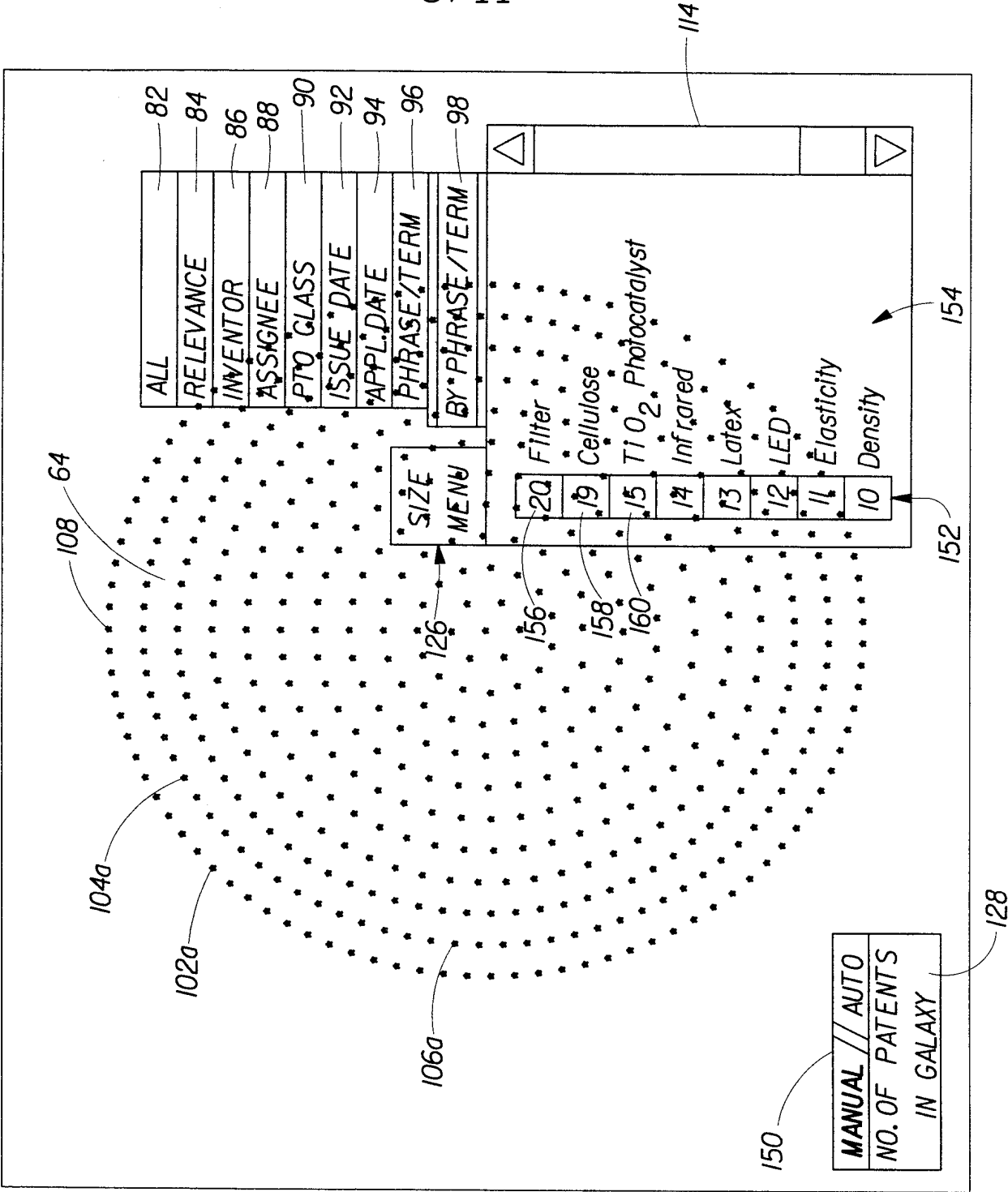
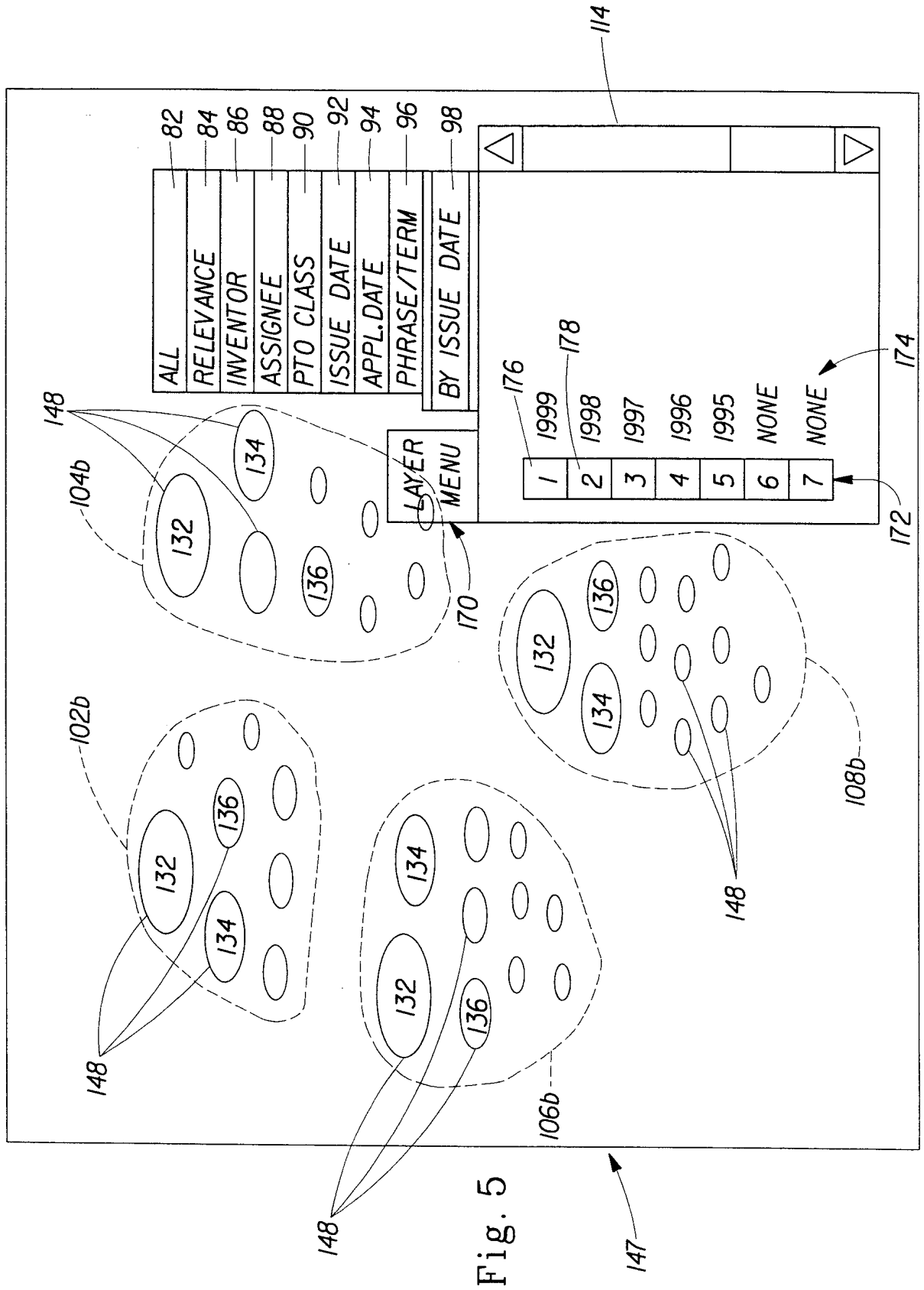


Fig. 4A



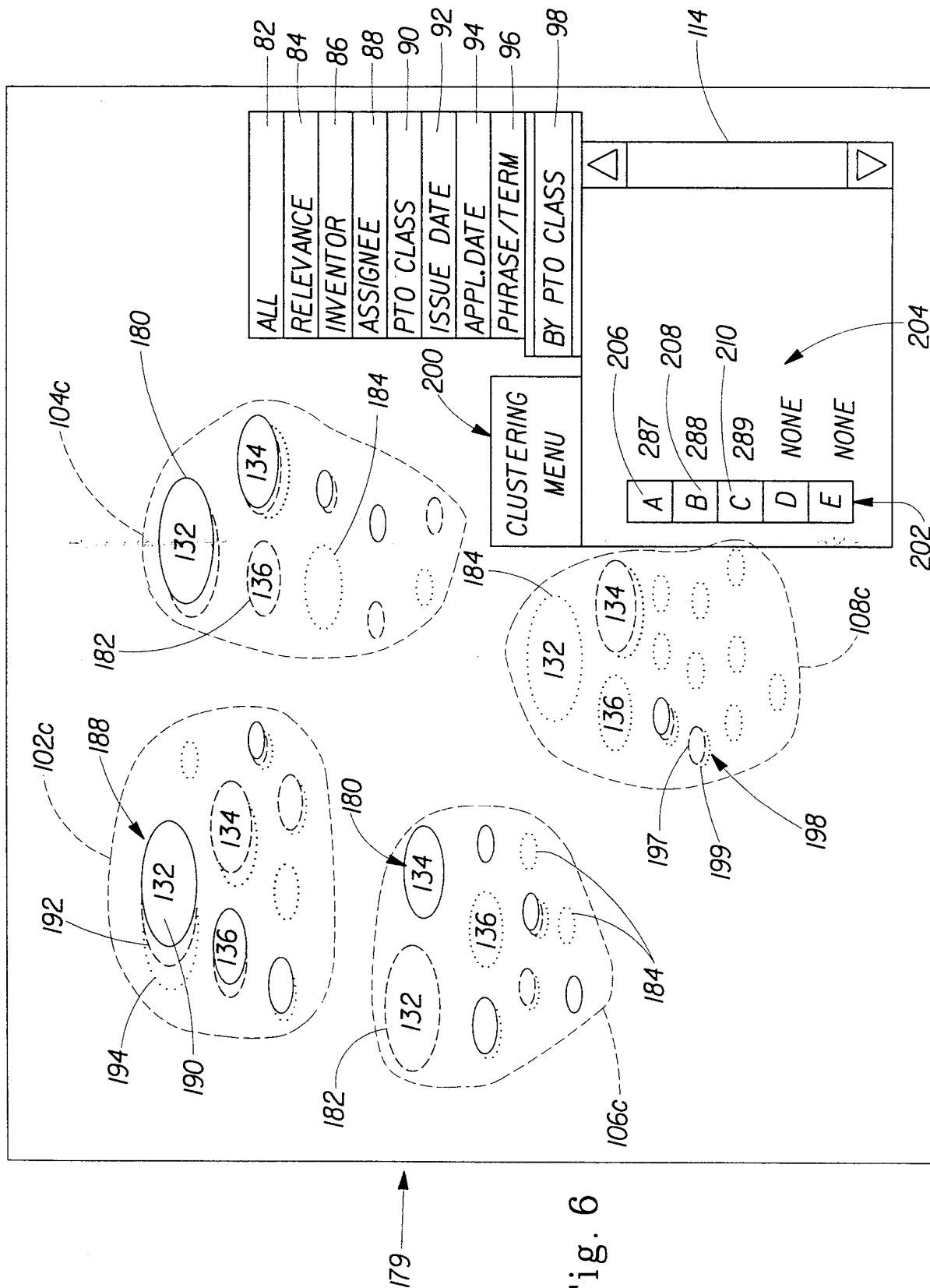
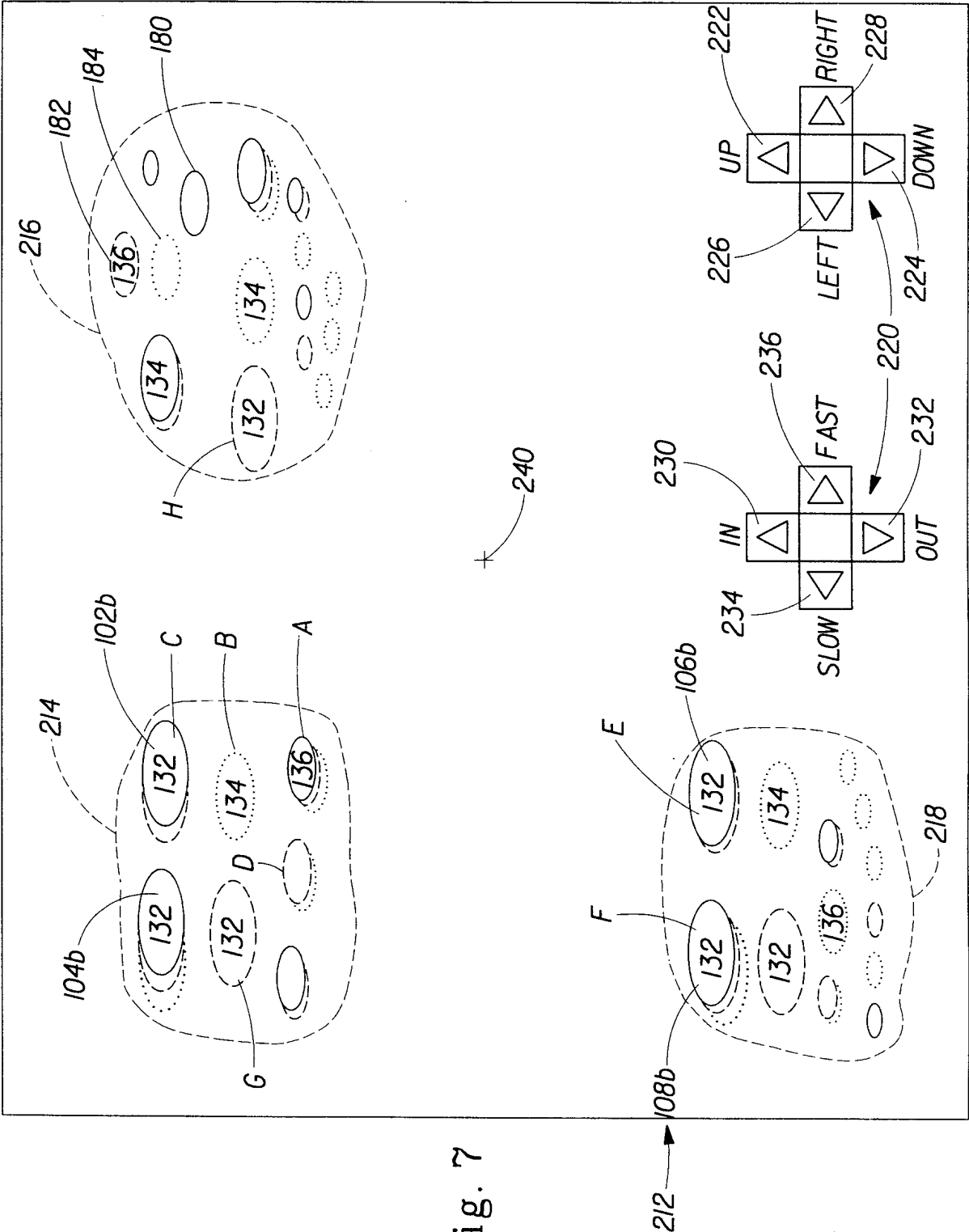


Fig. 6



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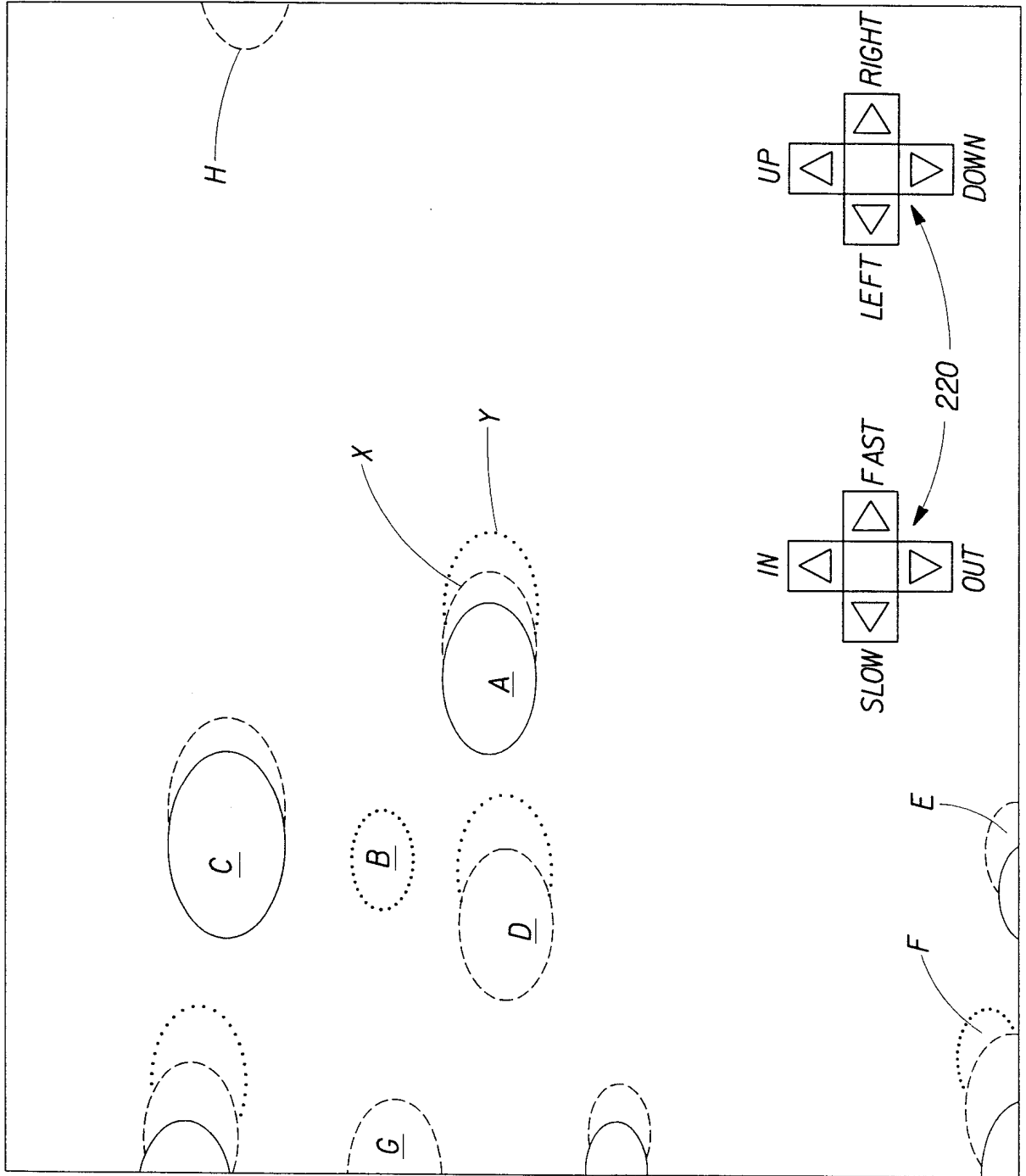


Fig. 8

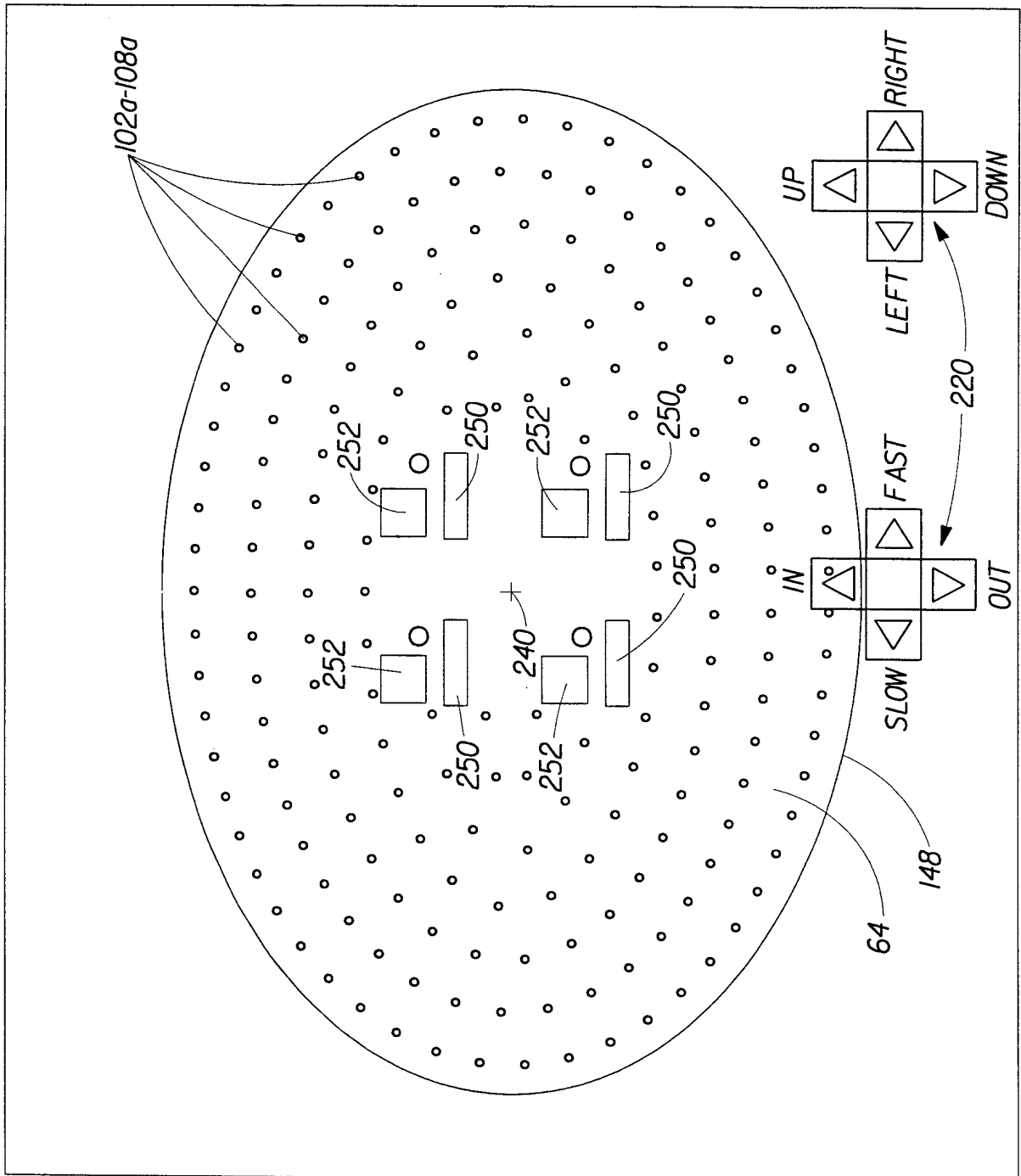
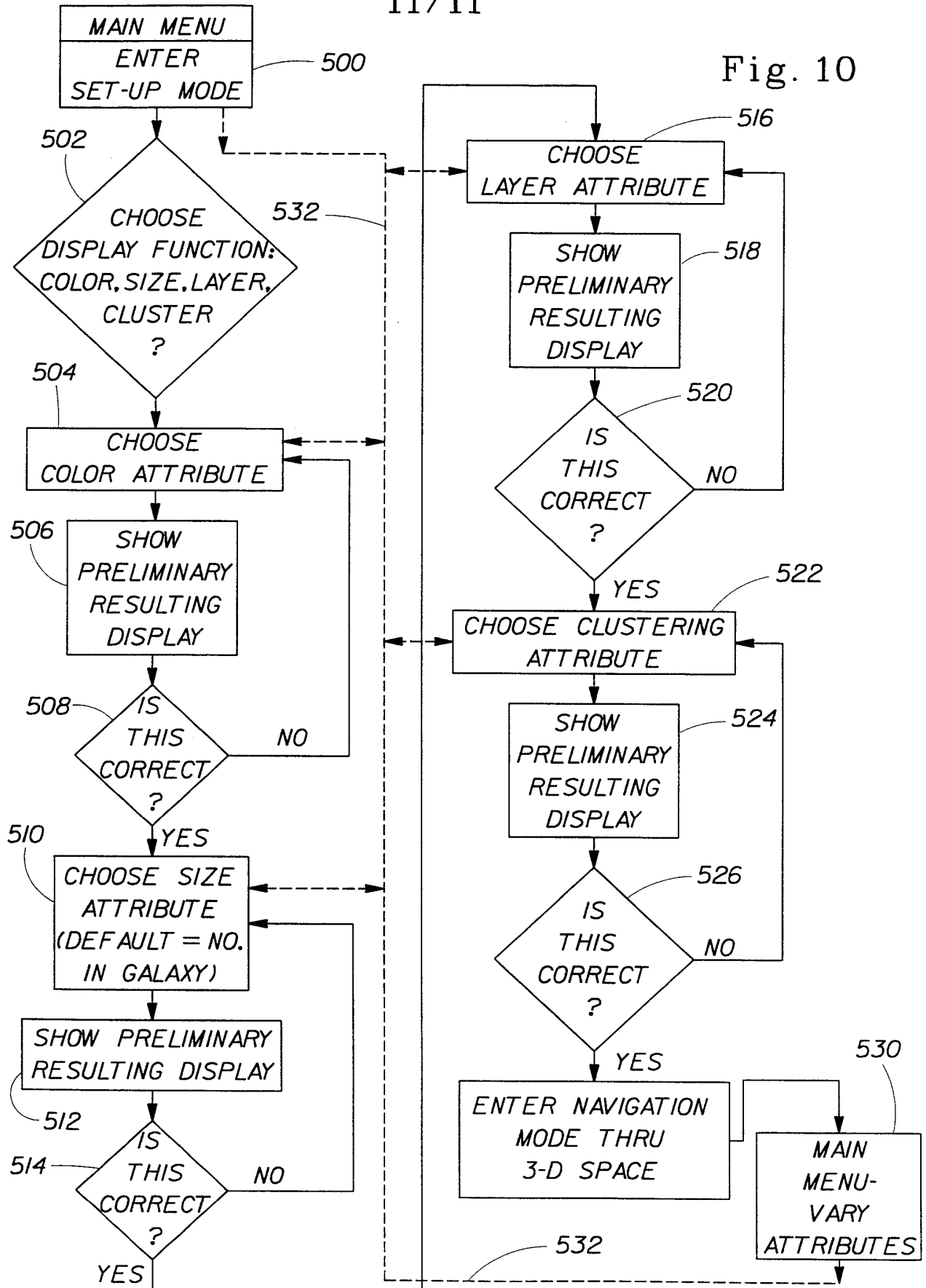


Fig. 9

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Fig. 10



INTERNATIONAL SEARCH REPORT

 International application No.
PCT/US00/06131

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : G06F 3/14

US CL : 345/357

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 345/326, 333, 334, 339, 355, 357, 968; 707/1, 3, 104

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS

search terms: three-dimensional, database, navigation

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,636,350 A (EICK et al) 03 June 1997, col. 2, lines 10-25, col. 3, line 30 to col. 5, line 38, figures 2-4.	1-18
Y	US 5,808,609 A (GUHA) 15 September 1998, abstract, col. 4, lines 9-19, figure 4.	1-18
A	US 5,812,134 A (POOSER et al) 22 September 1998, col. 3, lines 3-16, figure 5a.	1-18
A	US 5,555,354 A (STRASNICK et al) 10 September 1996, col. 2, lines 15-31, figure 1.	1-18
A	US 5,546,529 A (BOWERS et al) 13 August 1996, col. 2, lines 40-61, figure 12.	1-18

☐ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

* Special categories of cited documents	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"X"	document member of the same patent family
"U" document referring to an oral disclosure, use, exhibition or other means		
"P" document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search	Date of mailing of the international search report
17 MAY 2000	27 JUN 2000

 Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231
Facsimile No. (703) 305-3230

Authorized officer

CRESCELLE DELA

James R. Matthews

Telephone No. (703) 308-3800